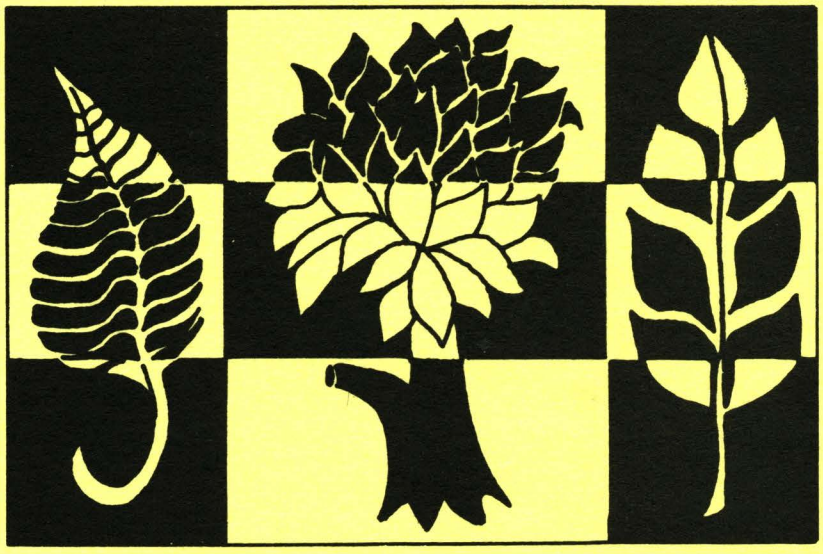
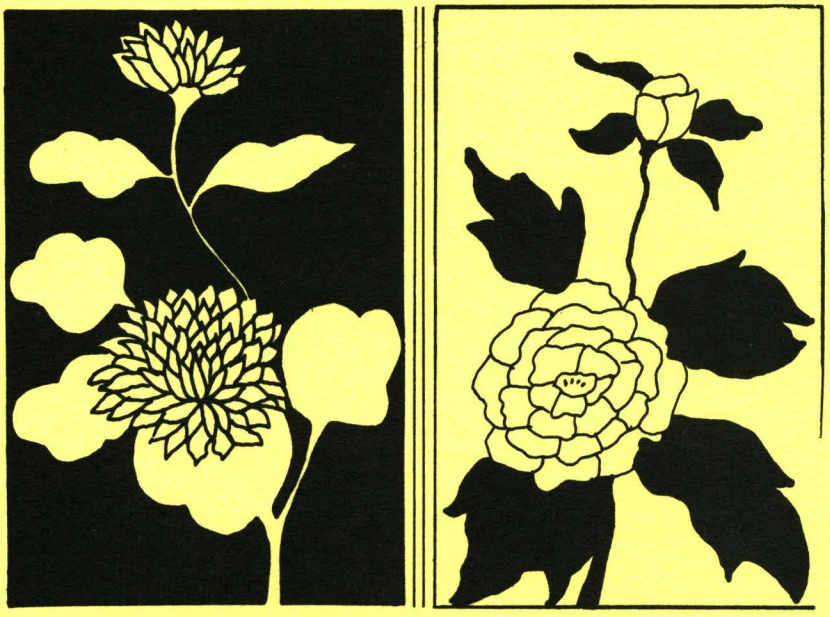
Research Report 273



Occupational Component Analysis in ORNAMENTAL HORTICULTURE

Phillip R. Zurbrick



AGRICULTURAL EXPERIMENT STATION • THE UNIVERSITY OF ARIZONA • TUCSON, ARIZONA 85721

Occupational Component Analysis in Ornamental Horticulture

A Research Project
of the
Department of Agricultural Education

by
Phillip R. Zurbrick

Research Report
273

Agricultural Experiment Station
University of Arizona
Tucson, Arizona
1974

FOREWORD

This is first in what is planned to be a series of component analyses designed to provide data on the competencies required for beginning employees within each component of the Agricultural Business and Natural Resources Cluster utilized in Arizona. The data, while not large in scope, represents a random sample of businesses (employers) employing persons in major job titles in ornamental horticulture in Arizona.

The data contained herein provides a necessary basis for developing and modifying curriculum materials and guides for specialized instructional programs in ornamental horticulture. Another important use of this material will be in assisting teachers in selecting and providing individualized instruction for students working in specific job areas in the ornamental horticulture component.

The initial list of competencies represented the work and thinking of many people in industry and education. The following vocational agriculture teachers assisted in gathering data for this study:

Richard Blair	Chinle High School
Mike Campbell	Kofa High School
Dennis Fiscus	University of Arizona
Adrian Hinton	Mesa High School
Richard Smith	Tolleson High School

TABLE OF CONTENTS

FOREWORD i

LIST OF TABLES iii

INTRODUCTION 1

PURPOSE OF STUDY 3

SPECIFIC OBJECTIVES OF STUDY 3

DELIMITATIONS 4

DEFINITIONS 4

PROCEDURE 6

- Identification of the population . . 6
- Selection of Sample 7
- Development of Questionnaire 8
- Method of Data Collection 8
- Analysis of Data 9

FINDINGS 10

- Returns 12
- Instructional Component Competencies 13
- Major Job Title Competencies 16
- Compatible Job Titles 29
- Kinds of Competencies 30
- Commonality of Competencies 31

CONCLUSIONS 33

RECOMMENDATIONS 34

SELECTED REFERENCES 36

APPENDIX A 37

APPENDIX B 42

LIST OF TABLES

Table		Page
1.	Employment in Major Job Titles in Ornamental Horticulture in Arizona	7
2.	Distribution of Questionnaires Returned by Major Job Titles in Ornamental Horticulture	12
3.	Instructional Component Competencies in Ornamental Horticulture as Rated by Industry Representatives for all Major Job Titles	13
4.	Instructional Competencies (Mean Value 4.0 or Greater) for Initial Employment of Nurserymen in Arizona as Rated by Industry Representatives	16
5.	Instructional Competencies (Mean Value 4.0 or Greater) for Initial Employment of Nursery Salesmen in Arizona as Rated by Industry Representatives	20
6.	Instructional Competencies (Mean Value 4.0 or Greater) for Initial Employment of Landscape Gardeners as Rated by Industry Representatives	22
7.	Instructional Competencies (Mean Value 4.0 or Greater) for Initial Employment of Greenskeepers in Arizona as Rated by Industry Representatives	26
8.	Number and Percentage of Shared Competencies Similarly Rated (4.0 or higher) by Industry Representatives in Arizona for Major Job Titles in Ornamental Horticulture	29
9.	Number of Instructional Component Competencies Categorized by Instructional Areas	31

OCCUPATIONAL COMPONENT ANALYSIS IN ORNAMENTAL HORTICULTURE

INTRODUCTION

Vocational education has historically been concerned with providing programs of instruction designed to fit individuals for gainful employment in recognized occupations. Agriculture, which was one of the earliest recognized occupations for which vocational training was provided, has continually been redefined and broadened to encompass a wider spectrum of occupations. An indication of this broadened scope can be gained from its present designation by the Federal Office of Education as "Agricultural Business and Natural Resources". Included in this employment cluster are seven instructional program areas or components. These components include: (1) Production, (2) Supplies/Service, (3) Mechanics, (4) Products, (5) Ornamental Horticulture, (6) Resources, (7) Forestry. Each of these components encompass a large number of individual job titles.

In order to provide an instructional program which will fit an individual for gainful employment in each of the components of the agricultural cluster, it is necessary to identify the competencies (skill and knowledge) required in each. The techniques of job analysis has been used for many years to develop a detailed list of duties, operations, and skills necessary to perform a clearly defined, specific job. The results of job analyses are commonly organized into a logical sequence which may be used for teaching, employment or classification purposes. While this is an accepted technique, it is not well adapted for analysis of a component encompassing many job titles due to the time and cost involved. Further, it has never been nor will it likely ever become educationally sound or economically feasible to train persons for a specific job. Thus, the instructional program must be

sufficiently broad to encompass many job titles and yet be specific enough to provide the necessary competencies required for gainful employment in the desired area of endeavor.

The ornamental horticulture component which is the focus of this report has been identified as one of the specialized programs which needs to be expanded and implemented in the State of Arizona. Research dealing with occupational opportunities has shown need for such a program. Zurbrick (1972:47) recommended that a specialized curriculum in "ornamental horticulture" be offered at the secondary level to provide training for entry level jobs in Pima County. He cited data showing 27 job titles in this component employing 422 people requiring competency in agriculture. The 422 positions represented over one-quarter of all persons employed in the county needing agricultural training. Further, employers indicated they expect a 21.8 per cent increase in employment in the next five years. Other evidence supporting the effort to expand and implement programs at the secondary level for training people in ornamental horticulture was the acceptance by employers of persons with high school training and at a minimum age comparable to that of the typical high school graduate.

The results of a component analysis must identify those competencies which are commonly considered essential by employers who hire persons in the major job titles in ornamental horticulture. Instructional programs and curriculum materials can then be designed to provide these essential competencies. Teachers can use the results of the study to help students identify competencies essential for specific jobs in ornamental horticulture and also in setting up individual training plans for students participating in agricultural cooperative education programs.

PURPOSE OF STUDY

The primary purpose of this study was to identify the competencies (skills and knowledge) considered by representatives of Arizona's ornamental horticulture industry to be most important for beginning employees to possess within major job titles in the industry. The identification was based upon the collective evaluation by industry representatives randomly selected from Arizona businesses known to employ such persons.

SPECIFIC OBJECTIVES OF THE STUDY

Answer to the following questions were sought in order to meet the specific objectives of the study.

1. Which of the competencies judged by industry representatives to be worthy of consideration in an instructional program for specific job titles, can be classified as "component competencies" for ornamental horticulture in Arizona?

2. Which competencies are considered by industry representatives to be worthy of consideration in an instructional program for beginning employees in major job titles within the ornamental horticulture component in Arizona?

3. Which job titles in the ornamental horticulture component are most compatible in terms of similar "instructional competencies" as rated by industry representatives?

4. What types of competencies are generally rated "instructional" by industry representatives in the ornamental horticulture component in Arizona?

5. How do the competencies identified in Arizona compare with those identified through research in other states?

DELIMITATIONS

The following factors should be considered when attempting to generalize the finding of this study.

1. The evaluation of competencies was limited to randomly selected industry representatives located in the State of Arizona and primarily in the southern desert areas. Competencies which might be considered essential in other areas may, because of environmental conditions peculiar to the desert area, be judged not essential in Arizona.

2. Only industry representatives known to employee persons in major job titles were included in the list from which names were randomly drawn.

3. A closed-form type of survey instrument was used, thus only the competencies included therein were evaluated. (See Appendix A)

4. Competencies were evaluated for the following major titles in ornamental horticulture as identified in Arizona:

   a. Greenskeeper
   b. Groundskeeper
   c. Laborer, Golf-Course
   d. Landscape Gardener
   e. Nurseryman
   f. Nursery Salesman
   g. Nursery Worker

5. The study was conducted in the latter half of 1973, thus the study was delimited to that period of time.

DEFINITIONS

The following terms, as defined below, were used in conducting and reporting this study.

Closed-form survey instrument: A device for measuring the value of competencies in which respondents are limited to both the number of alternatives and the number of competencies included in the instrument.

Competencies: Includes both knowledge and skills considered by industry representatives to be necessary for beginning employees to possess within specific job titles.

Component Analysis: A process designed to identify the competencies judged by employers to be necessary for beginning employees in each of several job titles within an occupational component.

Component competencies: Includes both knowledge and skills considered by industry representatives to be of sufficient importance for beginning employees in all major job titles within an occupational component to merit consideration in the instructional program.

Industry representatives: Includes both employers (businesses) employing persons in major job titles and persons presently employed in such job titles. In this study only employers were used.

Instructional competencies: Those competencies which have a mean value of four (4.0) or higher are considered to be of such value to merit consideration in an instructional program. This would include all competencies whose value would be considered "important" or "essential" as rated by industry representatives.

Major job titles: The ten most popular job titles within an occupational component having at least eighty persons employed in Arizona as determined through the accumulative Occupational Opportunities and Training Needs Studies conducted by the Department of Agricultural Education, University of Arizona, i.e. greenskeeper, nurseryman, etc.

Occupational cluster: A group of recognized occupations having many similarities in basic aptitudes, knowledge and training. The "Agribusiness and Natural Resources" group represents one such cluster.

Occupational component: A sub-category of an occupational cluster encompassing a smaller number of occupations more closely related in basic aptitude, knowledge and training. Ornamental horticulture is one of five such components in the "Agribusiness and Natural Resources" cluster recognized in Vocational Agriculture in Arizona.

Ornamental Horticulture: One of the functional or component parts of the "Agribusiness and Natural Resources" cluster. Emphasis is placed upon production, distribution and maintenance of plant materials and their arrangements in a pre-conceived plan. Knowledge and abilities associated with related service activities such as golf courses, ground maintenance, lawns, gardening and tree services are included in this area.

PROCEDURE

Identification of the Population

Identification of employers (businesses) sampled in this study was made from a list of businesses employing persons in major titles in the ornamental horticulture area. Both the list of employers and the determination of major job titles was based upon the cumulative occupational opportunities and training needs data reported by Zurbrick (1973:22) in Research Series Number Three. As pointed out by Zurbrick (1973:3) these data covered forty-one (41) high school and junior college districts within the State of Arizona in which a majority of the State's population resides. Specifically, businesses and occupational opportunities in all of Yuma and Pinal counties; most of Maricopa, Pima and Cochise counties; and parts of Yavapai county were included in the data from which the accessible population was identified. A total of 178 ornamental horticultural businesses primarily engaged in production, sales or maintenance of plants, shrubs or turf were included in the base data.

Seven job titles in ornamental horticulture were found to meet the criteria of a major job title - a minimum of eighty persons being employed. The numbers of full-time, part-time, and total employees in the major job titles is shown in Table 1.

In addition to the ornamental horticultural businesses primarily engaged in ornamental horticultural work, it was found that other businesses also employ persons in the major job titles included in Table 1. A total of 307 businesses were found who employed one or more persons in major horticultural job titles. The 307 businesses thus served as the accessible population from which a random sample was drawn.

TABLE 1

Employment in Major Job Titles in Ornamental Horticulture in Arizona*

Major Job Titles	Number of Employees Needing Knowledge or Skill in Agriculture		
	Full Time	Part Time	Total
Groundskeeper	305	25	330
Nursery Worker	133	182	315
Nurseryman	133	56	189
Landscape Gardner	134	49	183
Laborer, Golf Course	135	4	139
Nursery Salesman	113	21	134
Greenskeeper	80	0	80
Total	1033	337	1370

*Source. Occupational Opportunities and Training Needs for Agricultural Employment in Selected Areas in Arizona, Research Series Number Three, Department of Agricultural Education, University of Arizona, 1973.

Selection of the Sample

A random sample of forty businesses was drawn from the accessible population in the following manner. Each business employing persons in a major job title was assigned a number regardless of the number of persons employed. A table of random numbers was then used to select the sample. A business employing persons in two or more job titles was assigned a number for each, but once drawn a business was removed from all job titles, thus each business in the sample was asked to evaluate the competencies for only one job title in which it employed persons. The names and addresses of the businesses selected along with the job title for which they were asked to provide an evaluation are included in Appendix B.

Development of Questionnaire

The competencies included on the questionnaire were derived for several sources and were screened by industry representatives prior to being administered. Studies by Loewen (1970) in Oregon and Berkey, Drake and Legacy (1972) in New York were used to identify specific competencies. The Occupational Opportunity and Training Needs Studies by Hamilton and Zurbrick (1969, 1970, 1972) were used to identify areas in which Arizona businessmen felt competencies were needed for ornamental horticulture employees. Finally, the Specialized Curriculum in Ornamental Horticulture for Arizona (1972) was reviewed for additional competencies to be included in the questionnaire.

After the competencies had been synthesized from the above sources, they were checked for completeness and appropriateness with industry representatives located in the Tucson area. These representatives were not part of the random sample. Personal interviews were held at the time with the primary intent being to identify and include all possible competencies without regard to importance or extent of use. The final list of 181 competencies was thus formulated. (See Appendix A)

Method of Data Collection

The evaluation of the formulated competencies was gathered from the random sample of industry representatives using a questionnaire on which they were asked to check the usefulness of each competency. The representatives, who were generally the owners or managers of the selected businesses or in some cases the foremen in charge of persons in the selected major job title, were instructed to check one of the following four terms for each competency:

Essential - information or skill which a beginning employee must possess or be taught immediately in order to be employed in your business.

Important - information or skill which would be used in this job title but which can be learned on-the-job and which a new employee would not necessarily be expected to possess.

Useful - information or skill which would be nice to know, but which is not used regularly in this particular job title.

Not Needed - information or skill which is not needed or used by persons in this job title.

The physical gathering of the data was achieved through two methods, a mailed questionnaire and personal interviews with those not returning the questionnaire. Several steps were taken to help increase the number of questionnaires returned. These included: (1) Printing the questionnaire using colored ink on colored paper; (2) the inclusion of stamped self-addressed envelope for returning the instrument; (3) the inclusion of a personal cover letter on letterhead stationary explaining use and importance of the study; (4) the inclusion of a reward consisting of a "mini-pen" which the respondent was asked to use in completing the questionnaire and to keep for their cooperation.

Analysis of Data

A number was assigned to each of the four choices the respondents were asked to check as follows: essential - 7; important - 5; useful - 3; not needed - 1. Blanks or competencies in which more than one alternative was marked were recorded as nines (9) and were omitted in the calculation of mean values for each competency. All data was coded and placed on computer cards for processing.

Mean values were calculated for each competency using all returns to arrive at an overall value. Separate values were then calculated for each competency in each major job title in which there were at least five responses. The latter value was used as an indication of the importance of each competency for a specific job title, while the overall mean value was used to determine importance for all major job titles in the ornamental horticulture component.

A mean value of four (4.0) or higher was established as the criteria for an "instructional" competency for a particular job title and overall for those essential to all major job titles (component competency). The distribution of the overall mean values on all competencies by all respondents rounded to the nearest half value is shown in Figure 1. As can be seen in Figure 1, a majority of the competencies were rated non-instructional (less than 4.0). The distribution also indicates that the respondents were critical in the evaluation of the competencies and did not "rubber stamp" them.

A mean value of four (4.0) or higher indicated that the respondents considered the competency to be either "important" or "essential" for the particular job title on which the evaluation was made. When all evaluations were combined regardless of job titles a mean value of four (4.0) or higher indicated the competency was considered either "important" or "essential" for all major job titles in ornamental horticulture in Arizona. A mean value less than four (4.0) indicated that the respondents considered the competency to be either "not needed" or of a "nice to know" nature and thus classified as a non-instructional competency.

FINDINGS

The results of the fore mentioned procedures, carried out between July and December of 1973, are reported in the following paragraphs.

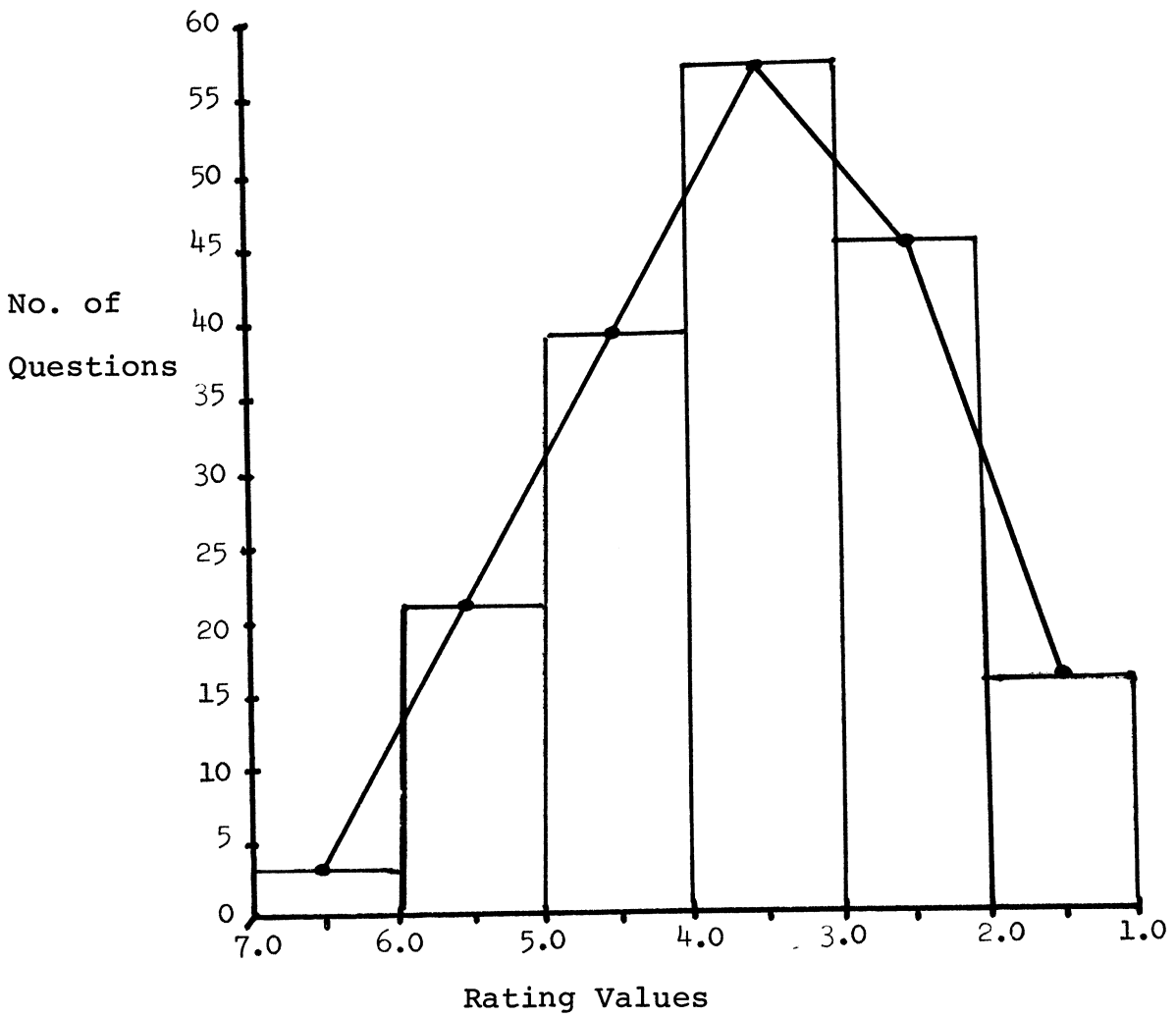


Fig. 1--Distribution of Rating Values on Horticulture Competencies - All job titles

N = 23

Returns

Completed and usable questionnaires were received via mail from fourteen (14) of the forty businesses included in the random sample. A total of six (6) businesses or fifteen percent of the sample were found to be out of business or to have changed ownership. Personal interviews were used to contact the non-respondents. Vocational agriculture teachers located close to the non-respondents were contacted and paid to conduct the personal interviews. The teachers were provided instruction on the purpose of the study and approved techniques in collecting the data through personal interview.

Through personal interviews a total of eleven (11) businesses were contacted and nine (9) questionnaires competed. The other two businesses did not wish to participate in the study. The twenty-three (23) completed returns thus represented over 57 percent of the original sample and over 67 percent of the original sample still in business. The number of questionnaires returned by major job titles is shown in Table 2.

TABLE 2

Distribution of Questionnaires Returned by Major Job Titles in Ornamental Horticulture

Major Job Titles	No. of Questionnaires Returned
Nurseryman	5
Nursery Salesman	5
Landscape Gardener	5
Greenskeeper	3
Nursery Worker	2
Groundskeeper	2
Laborer, Golf Course	1

Instructional Component Competencies

The first specific objective of this study dealt with the question of "which competencies were considered to be important enough to merit consideration in an instructional program for all major job titles in the ornamental horticulture field." An instructional competency has previously been defined as one having a mean value of four (4.0). Thus all usable returns regardless of job title were used to determine these instructional competencies. The instructional competencies and their mean value in ranked order are shown in Table 3.

TABLE 3

Instructional Component Competencies in Ornamental Horticulture as Rated by Industry Representatives for all Major Job Titles

N = 23

Competency	Mean Value
Listen and observe	6.30
Maintain good relations with customers and fellow workers	6.22
Stay cheerful and helpful	6.13
Look neat and well groomed	5.87
Care for and water plants	5.70
Identify annual plants	5.61
Identify bi-annual plants	5.61
Understand personal safety and first aid	5.55
Understand chemical safety	5.45
Understand the types and uses of soil conditioners and mulches	5.45
Understand the effects of soil moisture on plants	5.36
Understand the effects of water on soil temperature	5.36
Identify perennial plants	5.36
Identify plant and soil problems	5.35
Understand effects on plant growth of "temperature", "humidity", and "light"	5.27

TABLE 3 (Con't)

Competency	Mean Value
Select and apply appropriate fertilizer for lawns and landscape plantings	5.26
Understand local climatic area for plant growth	5.18
Understand soil texture and structure	5.18
Identify grass species grown in Arizona by vegetative means	5.17
Keep employee time records	5.09
Identify the proper exposure for best plant growth for common landscape plants	5.09
Select appropriate soil conditions	5.00
Understand conditions for growth & development of plants	5.00
Understand organic matter and its components	5.00
Plant and transplant	4.91
Understand principles of sterilization (soils, buildings and plants)	4.91
Understand efficient water use	4.91
Stake and tie plants	4.83
Control plant disease	4.83
Identify weeds	4.83
Explain or relay product knowledge	4.83
Select chemicals for disease, insect or rodent control	4.73
Understand absorption rates of different soil types	4.73
Understand the functions of living organism in the soil	4.73
Prepare topsoil for seeding	4.65
Plant a lawn (seeding, plugging, or sprigging)	4.65
Identify plant diseases of trees	4.62
Store live materials	4.57
Operate seeders and fertilizer applicators	4.57
Correct plant and soil problems	4.56
Determine soil texture	4.48
Identify plant disease of shrubs and bushes	4.48
Mix and handle chemicals	4.48
Operate a truck	4.48

TABLE 3 (Con't)

Competency	Mean Value
Operate sprayers and dusters	4.48
Fertilize nursery stock	4.39
Apply systemic chemicals (fungicides, fertilizers, insecticides)	4.39
Understand plant processes	4.36
Identify plant diseases of nursery stock	4.30
Identify plant diseases of flowers	4.30
Operate tractors	4.30
Operate small gas engine	4.30
Prepare a mulch	4.22
Prune nursery stock	4.22
Identify insect injury in ornamentals	4.22
Sell products and services	4.22
Understand plant parts and their functions	4.18
Keep records of expenses and receipts	4.13
Identify insect injury in nursery stock	4.04
Lay sod	4.04
Culture bedding plants	4.00
Understand the life cycles of plants	4.00

A total of sixty-three (63) competencies were identified as instructional (mean value greater than 4.0) from the list of 181 included in the study. Twenty-four competencies had a mean value of five (5.0) or higher.

Perhaps nearly as interesting as the list of competencies rated "instructional" (4.0 or higher) are the ones which were not so rated. Fourteen competencies had a mean rating of less than two (2.0) and thus were considered "not needed" by the respondents. Included in this list were competencies Number 11 through 16 (See appendix A) all of which dealt with asexual methods of propagation. Several of the other "not needed" competencies could be considered closely associated with job titles not included in this study. For example, two compe-

tencies (Numbers 71 and 72, Appendix A) dealing with floral arrangement and design were rated as "not needed". Also, competencies 85 and 86 (See Appendix A) having to do with stump removers and aerial tree trimming units were rated low. In the mechanics area, skills in: (1) cutting and replacing glass, (2) constructing cold frames and (3) constructing hot beds were considered not needed. The low rating for the latter three competencies can perhaps be explained by the weather conditions unique to Arizona and the relative small number of glass greenhouses in the State.

Major Job Title Competencies

The competencies considered instructional (mean value 4.0 or higher) by industry representatives for each major job title for which three or more completed returns were received was determined to answer the question posed in specific objective number two. Those competencies judged by industry representatives as being worthy of instructional consideration for beginning nurserymen is shown in Table 4.

TABLE 4

Instructional Competencies (mean value 4.0 or greater) for Initial Employment of Nurserymen in Arizona as Rated by Industry Representatives
N = 4

Competency	Mean Value
Maintain good relations with customers	6.50
Identify the proper exposure for best plant growth for common landscape plants	6.50
Listen and observe	6.00
Stay cheerful and helpful	6.00
Look neat and well groomed	6.00
Identify bi-annual plants	6.00
Identify annual plants	6.00
Identify perennial plants	6.00

TABLE 4 (Con't)

Competency	Mean Value
Understand the types and uses of soil conditioners and mulches	5.67
Understand local climatic area for plant growth	5.67
Understand scientific names of plants	5.67
Care for and water plants	5.50
Select and apply appropriate fertilizer for lawns and landscape plantings	5.50
Keep employee time records	5.50
Control plant disease	5.50
Identify weeds	5.50
Select chemicals for disease, insect or rodent control	5.50
Identify plant disease of nursery stock	5.50
Identify insect injury in ornamentals	5.50
Sell products and services	5.50
Identify insect injury in nursery stock	5.50
Operate a cash register	5.50
Help customers select what they need	5.50
Understand personal safety and first-aid	5.00
Understand chemical safety	5.00
Understand the effects of soil moisture on plants	5.00
Understand the effects of water on soil temperature	5.00
Understand effects on plant growth of "temperature", "humidity", and "light"	5.00
Understand soil texture and structure	5.00
Understand conditions for growth and development of plants	5.00
Understand organic matter and its components	5.00
Understand principles of sterilization (soils, buildings, and plants)	5.00
Stake and tie plants	5.00
Explain or relay product knowledge	5.00
Identify plant disease of trees	5.00
Store live plant materials	5.00

TABLE 4 (Con't)

Competency	Mean Value
Understand plant processes	5.00
Prepare a mulch	5.00
Interpret a landscape plan	5.00
Arrange stock and make displays	5.00
Order stock	5.00
Read sales tax table	5.00
Understand horticultural products and their uses	5.00
Identify plant and soil problems	4.50
Select appropriate soil conditions	4.50
Mix and handle chemicals	4.50
Fertilize nursery stock	4.50
Apply systemic chemicals (fungicides, fertilizers, insecticides)	4.50
Prune nursery stock	4.50
Do selective trimming and shaping trees	4.50
Read scales	4.50
Understand efficient water use	4.33
Understand absorption rates of different soil types	4.33
Understand the functions of living organism in the soil	4.33
Correct plant and soil problems	4.33
Understand plant parts and their functions	4.33
Understand the life cycles of plants	4.33
Understand the using of credit	4.33
Understand marketing principles	4.33
Understand market outlets and trends	4.33
Understand the principles of landscape design	4.33
Identify grass species grown in Arizona by vegative means	4.00
Plant and transplant	4.00
Prepare topsoil for seeding	4.00
Plant a lawn (seeding, plugging, or sprigging)	4.00
Operate sprayers and dusters	4.00
Trim hedges	4.00

TABLE 4 (Con't)

Competency	Mean Value
Layout and construct flower beds	4.00
Keep inventory and stock records	4.00

It should be pointed out that seventy-seven (77) competencies had a mean value of 4.0 or higher for the job title of nurseryman as compared to 63 for the combined analysis of all job titles. The highest rated competency for nurseryman not judged instructional in the overall analysis (Table 3) was "understanding of scientific names of plants" which was rated 5.67. Six of the instructional component competencies were not so rated for a nurseryman. These included:

1. Laying sod
2. Operating small gas engines
3. Culturing bedding plants
4. Operating a tractor
5. Operating a truck
6. Operating seeder and fertilizer applicators.

A comparison of the essential competencies identified in this study with those identified by Loewen in Oregon (1970) and by researchers in Florida (1972) show some striking differences. For example, the highest rated educational objective identified for nursery operations in Florida had to do with cleaning and storage of fertilizer applicators, while the operation of seeders and fertilizer applicators was rated 3.50 in Arizona. A possible explanation for this seeming conflict could be found in the type of nursery operations included in the studies. The Arizona nurseries were primarily retail nurseries rather than production nurseries. This perhaps explains the low rating placed on such competencies as operation of trucks, tractors and other pieces of production equipment.

A total of fifty-six (56) competencies were identified as "Instructional" for a nursery salesman. (See Table 5) It should be noted that this was the fewest competencies so considered for any one of the major job titles. Seventeen of

of the component competencies were omitted from Table 5 due to low ratings. Skill in "helping customers select what they need" was the highest rated skill not included in the component competencies. Skills in merchandizing and salesmanship were, as expected, considered "instructional" for a nursery salesman.

TABLE 5

Instructional Competencies (Mean Value 4.0 or Greater) for Initial Employment of Nursery Salesmen in Arizona as Rated by Industry Representatives

N = 5

Competency	Mean Value
Stay cheerful and helpful	6.60
Identify annual plants	6.60
Sell products and services	6.60
Help customers select what they need	6.60
Identify bi-annual plants	6.20
Identify perennial plants	6.20
Identify grass species grown in Arizona by vegetative means	6.20
Look neat and well groomed	6.20
Listen and observe	5.80
Maintain good relations with customers and fellow workers	5.80
Identify the proper exposure for best plant growth for common landscape plants	5.80
Select appropriate soil conditioners	5.80
Explain or relay product knowledge	5.80
Identify plant diseases of trees	5.80
Read sales tax table	5.80
Culture bedding plants	5.50
Care for and water plants	5.40
Understand the types and uses of soil conditioners and mulches	5.40
Understand the effects of soil moisture on plants	5.40
Understand the effects of water on soil temperature	5.40

TABLE 5 (Con't)

Competency	Mean Value
Identify plant and soil problems	5.40
Select and apply appropriate fertilizer for lawns and landscape plantings	5.40
Control plant disease	5.40
Store live plant material	5.40
Identify plant diseases of shrubs and bushes	5.40
Identify plant diseases of nursery stock	5.40
Identify plant diseases of flowers	5.40
Understand personal safety and first aid	5.00
Understand chemical safety	5.00
Understand effects of plant growth of "temperature", "humidity", and "light"	5.00
Understand soil texture and structure	5.00
Keep employee time records	5.00
Understand organic matter and its components	5.00
Select chemicals for disease, insect or rodent control	5.00
Correct plant and soil problems	5.00
Identify insect injury in trees	5.00
Identify insect injury in ornamentals	5.00
Identify insect injury in nursery stock	5.00
Understand horticultural products and their uses	5.00
Understand conditions for growth and development of plants	4.60
Identify weeds	4.60
Understand absorption rates of different soil types	4.60
Understand the functions of living organisms in the soil	4.60
Fertilize nursery stock	4.60
Make out monthly statements	4.60
Order stock	4.60
Understand profit maximizing principles	4.60
Understand marketing principles (price determination)	4.60
Stake and tie plants	4.50

TABLE 5 (Con't)

Competency	Mean Value
Understand local climatic area for plant growth	4.20
Plant and transplant	4.20
Understand the principles of sterilization (soils, buildings, and plants)	4.20
Understand plant parts and their functions	4.20
Arrange stock and make displays	4.20
Read scales	4.20
Understand market outlets and trends	4.20
Understand management in a retail store	4.20

The greatest number of competencies (91) were rated "instructional" for landscape gardeners. (See Table 6) Industry representatives who evaluate the needs of landscape gardeners failed to rate eight of the component competencies at four (4.0) or higher. These were:

1. Controlling plant disease
2. Correcting plant soil problems
3. Identifying plant diseases of shrubs and bushes
4. Identifying insect injury in trees
5. Identifying plant diseases of nursery stock
6. Identifying plant diseases of flowers
7. Identifying insect injury in ornamentals
8. Identifying insect injury in nursery stock

TABLE 6

Instructional Competencies (Mean Value 4.0 or Greater) for Initial Employment of Landscape Gardeners as Rated by Industry Representatives

Competency	Mean Value
Listen and observe	7.00
Maintain good relations with customers and fellow workers	7.00
Stay cheerful and helpful	6.60
Look neat and well groomed	6.60
Understand personal safety and first aid	6.60

TABLE 6 (con't)

Competency	Mean Value
Understand local climatic area for plant growth	6.60
Understand efficient water use	6.60
Plant a lawn (seeding, plugging, sprigging)	6.60
Operate a truck	6.60
Operate tractors	6.60
Operate small gas engine	6.60
Understand chemical safety	6.20
Select and apply appropriate fertilizer for lawns and landscape plantings	6.20
Understand principles of sterilization (soils, buildings, and plants)	6.20
Identify annual plants	5.80
Understand the types and uses of soil conditioners and mulches	5.80
Understand the effects of soil moisture on plants	5.80
Understand the effects of water on soil temperature	5.80
Identify plant and soil problems	5.80
Identify the proper exposure for best plant growth for common landscape plants	5.80
Operate seeders and fertilizer applicators	5.80
Lay sod	5.80
Operate tillage equipment	5.80
Understand profit maximizing principles (economic principles)	5.80
Care for and water plants	5.40
Identify bi-annual plants	5.40
Understand effects of "temperature", humidity", and "light" on plant growth	5.40
Understand soil texture and structure	5.40
Identify grass species grown in Arizona by vegetative means	5.40
Keep employee time records	5.40
Plant and transplant	5.40
Stake and tie plants	5.40
Understand absorption rates of different soil types	5.40

TABLE 6 (Con't)

Competency	Mean Value
Prepare topsoil for seeding	5.40
Operate sprayers and dusters	5.40
Understand plant processes	5.40
Understand plant parts and their functions	5.40
Understand the life cycle of plants	5.40
Reseed a turf lawn	5.40
Irrigate turf	5.40
Operate a chain saw	5.40
Perform preventive maintenance on lawn and garden machinery	5.40
Perform daily care and maintenance on tractors	5.40
Make minor repair on small gas engines	5.40
Condition garden tools (sharpen and/or repair)	5.40
Lubricate moving parts on machinery	5.40
Lay out and construct flower beds	5.40
Grade a site	5.40
Interpret a landscape plan	5.40
Understand the principles of landscape design	5.40
Understand conditions for growth and development of plants	5.00
Understand organic matter and its components	5.00
Understand the functions of living organism in the soil	5.00
Fertilize nursery stock	5.00
Prepare a mulch	5.00
Sell products and services	5.00
Keep records of expenses and receipts	5.00
Prepare a soil nutrient solution with pre-mixed chemicals	5.00
Maintain small gas engines	5.00
Adjust and service belts and pulleys	5.00
Explain or relay product knowledge	4.60
Store live plant material	4.60
Apply systemic chemicals (fungicides, fertilizers, insecticides)	4.60
Select and use plant growth substances	4.60

TABLE 6 (Con't)

Competency	Mean Value
Do selective trimming and shaping trees	4.60
Renovate old lawns	4.60
Maintain electric motors	4.60
Install and maintain sprinkler irrigation system	4.60
Repair and adjust tractors	4.60
Understand cell and tissue structures of plants	4.60
Understand marketing principles (price determination)	4.60
Understand market outlets and trends	4.60
Select chemicals for disease, insect or rodent control	4.20
Determine soil texture	4.20
Mix and handle chemicals	4.20
Prune nursery stock	4.20
Culture bedding plants	4.20
Trim hedges	4.20
Mow and edge lawns	4.20
Treat plant wounds and cuts	4.20
Operate and service small electrical tools	4.20
Operate reel, rotary and sickle bar mowers	4.20
Adjust carburetors	4.20
Sketch and lay out a landscape plan	4.20
Read scales	4.20
Understand scientific names of plants	4.20
Understand the disease cycle of pathogenetic organisms	4.20
Understand issuing credit	4.20
Understand low maintenance upkeep of recreational facilities	4.20
Identify weeds	4.20
Identify plant diseases of trees	4.00

A total of thirty-eight (38) competencies in addition to the fifty-five (55) component competencies were ranked worthy of instructional consideration for landscape gardeners. Of the thirty-eight (38) additional competencies, twenty-nine (29)

involved skills many of which required manipulative ability. A landscape gardener would appear to be a very versatile individual capable of doing many jobs. The number of mechanical skills involved with this job title supports the need for a strong instructional program in mechanics as part of the curriculum in ornamental horticulture.

Table 7 includes the competencies rated "instructional" for a beginning greenskeeper in Arizona listed in order of mean values from highest to lowest. The greenskeeper had the second fewest competencies (72) so rated among the major job titles analyzed.

TABLE 7

Instructional Competencies (Mean Value 4.0 or Greater) for Initial Employment of Greenskeeper in Arizona as Rated by Industry Representatives
N = 3

Competency	Mean Value
Listen and observe	7.00
Maintain good relations with customers and fellow workers	7.00
Understand chemical safety	7.00
Correct plant and soil problems	7.00
Operate and service small electric tools	7.00
Repair and adjust tractors	7.00
Adjust carburetors	7.00
Lubricate moving parts on machinery	7.00
Care for and water plants	6.33
Understand personal safety and first aid	6.33
Understand the types and uses of soil conditioners and mulches	6.33
Understand the effects of soil moisture on plants	6.33
Understand the effects of water on soil temperature	6.33
Identify plant and soil problems	6.33
Understand the effects of "temperature", "humidity", and "light" on plant growth	6.33

TABLE 7 (Con't)

Competency	Mean Value
Understand local climatic area for plant growth	6.33
Understand soil texture and structure	6.33
Understand conditions for growth and development of plants	6.33
Prepare topsoil for seeding	6.33
Operate seeders and fertilizer applicators	6.33
Mix and handle chemicals	6.33
Operate a truck	6.33
Operate sprayers and dusters	6.33
Apply systemic chemicals (fungicides, fertilizers, insecticides)	6.33
Operate tractors	6.33
Operate small gas engines	6.33
Lay sod	6.33
Mow and edge lawns	6.33
Reseed a turf area	6.33
Renovate old lawns	6.33
Irrigate turf	6.33
Operate tillage equipment	6.33
Operate reel, rotary and sickle bar mowers	6.33
Maintain small gas engines	6.33
Perform daily care and maintenance on tractors	6.33
Adjust and service belts and pulleys	6.33
Install and maintain sprinkler irrigation system	6.33
Select and apply appropriate fertilizer for lawns and landscape plantings	5.67
Identify grass species grown in Arizona by vegatative means	5.67
Select appropriate soil conditioners	5.67
Understand organic matter and its components	5.67
Control plant disease	5.67
Identify weeds	5.67
Understand the functions of living organism in the soil	5.67
Plant a lawn (seeding, plugging, or sprigging)	5.67

TABLE 7 (Con't)

Competency	Mean Value
Determine soil texture	5.67
Maintain electric motors	5.67
Stay cheerful and helpful	5.00
Keep employee time records	5.00
Plant and transplant	5.00
Understand principles of sterilization (soils, buildings, and plants)	5.00
Understand efficient water use	5.00
Select chemicals for disease, insect or rodent control	5.00
Understand absorption rates of different soil types	5.00
Understand plant processes	5.00
Prepare a mulch	5.00
Prepare a soil nutrient solution with pre-mixed chemicals	5.00
Operate a chain saw	5.00
Make minor repair on small gas engines	5.00
Condition garden tools (sharpen and/or repair)	5.00
Understand low maintenance upkeep or recreational facilities	5.00
Look neat and well groomed	4.33
Explain or relay product knwledge	4.33
Keep records of receipts and expenses	4.33
Select and use plant growth substances	4.33
Treat plant wounds and cuts	4.33
Grade a site	4.33
Order stock	4.33
Keep inventory and stock records	4.33
Understand the disease cycle of pathogenic organisms	4.33
Understand the principles of landscape design	4.33

Compatible Job Titles

The question of compatibility of major job titles in ornamental horticulture was raised in specific objective three. Compatibility was described in terms of the degree of agreement on competencies rated "instructional" by industry representatives for major job titles. Two job titles in which competencies were similarly evaluated would be considered compatible. for instructional purposes, while a third job title requiring many different competencies would be considered less compatible.

Table 8 shows the number of competencies with a mean rating of four (4.0) or higher for specific job titles that were common between major job titles.

TABLE 8

Number and Percentage of Shared Competencies Similarly Rated (4.0 or higher) by Industry Representatives in Arizona for Major Job Titles in Ornamental Horticulture

Job Titles	Number of "Instructional" Competencies for the paired Job Titles (col. #1)	Number of Shared "Instructional" Competencies (col. #2)	Percentage of Agreement*
Nursery Salesman-Nurseryman	133	56	83%
Greenskeeper-Landscape Gardener	163	68	84%
Nurseryman-Landscape Gardener	168	61	73%
Nursery Salesman-Landscape Gardener	147	42	57%
Greenskeeper-Nurseryman	149	41	55%
Nursery Salesman-Greenskeeper	128	30	47%

* Percentage of Agreement = $\frac{\text{(col. \#2 x 2)}}{\text{col. \#1}}$ x 100

The percentage of shared instructional competencies provides a measure of the compatibility of the job titles. As can be seen in Table 8 the most compatible job titles from a training standpoint were: (1) nursery salesman and nurseryman, (2) greenskeeper and landscape gardeners. The least compatible were:

1. Nursery Salesman - Landscape Gardeners
2. Greenskeeper - Nurseryman
3. Nursery Salesman - Greenskeeper

Kinds of Competencies

An analysis of the competencies considered by industry representatives to be important in ornamental horticulture provides some indication as to where emphasis should be placed and the type of instruction which is appropriate. All of the 181 original competencies were placed in one of the following mutually exclusive instructional areas: (1) Production, 49; (2) Mechanics, 42; (3) Design and plant maintenance, 33; (4) Management, 35; (5) Salesmanship and human relations, 17. The number following each instructional area indicates the number of competencies from the original list included in that area. All of the understanding types of competencies (no. 148-181, Appendix A) were included in the management classification. The results of the analysis using the sixty-three (63) "instructional component" competencies included in Table 3, shows the importance of the knowledge competencies. (See Table 9).

It should be pointed out that the four competencies with the highest mean rating from all respondents dealt with human relations skills. This demonstrates the danger of structuring an instructional program around the majority of competencies and, as in this case, omitting the most important competencies as judged by industry representatives.

TABLE 9

Number of Instructional Component Competencies Categorized by Instructional Areas

Instructional Areas	Number of Competencies rated as "Instructional Component" Competencies
Production	30
Management	17
Salesmanship & Human Relations	8
Mechanics	5
Design & Plant Maintenance	3

Identification skills were in evidence among the 63 component competencies with 14 listed. Four competencies imply the ability to make decisions as denoted by the term "select" and "determine", while seventeen competencies dealt with "understanding" denoting reasoning ability. This seems to support the need for developing the thinking, reasoning and decision making abilities for students preparing for careers in the field of ornamental horticulture.

Commonality of Competencies

Question number five under the specific objectives for the study deals with the commonality of competencies in the instructional area of ornamental horticulture identified in Arizona and other states. Similar studies conducted in Oregon (1970) and Florida (1973) were used for comparison purposes.

Loewen,in Oregon, started with one hundred competencies which were identified as important to the satisfactory performance of typical workers in seven occupational groups in ornamental horticulture. The seven groups involved included florists, landscapers and workers in garden centers, greenhouses, nurseries, golf courses and parks. The groups used in Oregon were similar to the seven major job titles included

in this study with the exception of the florists who were omitted in Arizona.

Of the original one hundred competencies used in Oregon a total of 45 competencies were identified as being important and common to all seven occupational categories. This compares with the 181 original competencies used in Arizona of which 63 were found to be important and common to the major job titles in the industry.

The human relations and communications skills were found to be most important in both Oregon and Arizona. Also, the specialized competencies dealing with floral and landscape design were rated least important in both states.

A comparison of the number of competencies identified as important by areas or major job titles also reveals some commonalities. The largest number of competencies were identified for the landscape gardener in Arizona with 91, while in Oregon the landscaper and garden center group identified the largest number with 64 competencies.

The study in Florida used a slightly different approach in that educational objectives rather than occupational competencies were used and evaluated by industry representatives. Also, the Florida work was more restrictive in scope, dealing with only nursery operations in the ornamental horticulture component of agriculture.

A total of 433 objectives were identified and evaluated in Florida. Out of the 433 objectives a total of fifty-two (52) were identified as high priority items for entry level nursery workers. Again, this compares with the forty-five identified in Oregon and the sixty-three in Arizona. The Florida study did not include any objectives in the area of "human relations, business and communications skills" although this was a recognized area in their construct.

A comparison of the fifty-two (52) high priority objectives in Florida with the instructional component competencies in Arizona showed that twenty-three (23) of the objectives were comparible and all but eight (8) were included in the Arizona study. The eight not included were educational objectives which could logically be expected to be taught in developing the competencies included in the Arizona study. Considering the scope of the two studies and the differences between educational objectives and occupational competencies the two studies were complimentary and supportive.

CONCLUSIONS

The findings of this study support the following conclusions:

1. There is a group of competencies common to the several major job titles in ornamental horticulture which are necessary for beginning employees to possess.

2. Even among the most divergent of the major job titles there was still a common core of competencies which should be included in an instructional program designed to prepare persons for employment in ornamental horticulture.

3. Human relation and communication skills, while not great in number, were considered by industry representatives to be very essential for beginning employees.

4. Considerable emphasis should be placed upon the development of thinking, reasoning and decision making skills in training ornamental horticulture employees. However, not all job titles were equally demanding in this respect.

5. The number and nature of competencies considered important for beginning employees in major job titles do vary and thus may require some individualized instruction even when all students in a specialized ornamental horticulture program are employed in that field.

6. That while some small differences existed between the findings of studies designed to identify necessary competencies required in the area of ornamental horticulture conducted in various states, the results tend to compliment and support rather than dispute and confuse. Therefore, it does not seem necessary to conduct similar studies in each state.

7. That the use of the component analysis technique can be effectively utilized to identify and evaluate those competencies which should be included in an instructional program designed to prepare students for gainful employment in specialized areas or components of the agri-business and natural resources cluster.

8. The combining of the technique of component analysis with occupational opportunity data provides a logical means of limiting the investigation and provides results which should be considered in an instructional program designed to develop competencies required for gainful employment.

RECOMMENDATIONS

The following recommendations are suggested for the reader's consideration:

1. That curriculum guides and instructional materials in ornamental horticulture be developed or revised based upon the component competencies identified by industry representatives as being needed for beginning employees.

2. That the instructional competencies for major job titles in ornamental horticulture be used by teachers and coordinators to develop individualized assignments and training plans for students desiring employment in such jobs.

3. That the instructional component competencies identified in this study be used to write performance objectives designed to develop the needed competencies.

4. That emphasis be placed upon developing human relations skills both in the classroom and on the job. Agricultural cooperative education classes would be very appropriate for developing such skills.

5. That future component analyses in vocational agriculture utilize the personal interview in collecting data rather than mailed questionnaires.

6. That the results of studies designed to identify and evaluate competencies in specialized instructional areas be cooperatively developed, conducted and the result shared between states on a regional basis. A national effort to identify and evaluate occupational competencies might prove to be both productive and beneficial for curriculum development purposes.

Selected References

Berkey, Arthur L.; Drake, William E.; and Legacy, James W. A Model for Task Analysis in Agri-Business, Cornell University, Ithaca, New York, 1972.

Florida Department of Education, Division of Vocational, Technical and Adult Education, The Florida Catalog of Occupational Education Objectives, Series: Agricultural Occupations, part; Ornamental Horticulture, Nursery Operations. Tallahassee, Florida; 1973

Hamilton, James B. Occupational Opportunities and Training Needs for Agricultural Employment in Selected Areas of Arizona - Pinal County. Research Report 262, Agricultural Experiment Station, University of Arizona, Tucson, 1970

Hamilton, James B. Occupational Opportunities and Training Needs for Agricultural Employment in Selected Areas of Arizona - Eastern Maricopa County, Research Report 264, Agricultural Experiment Station, University of Arizona, Tucson, 1971

Hamilton, James B. Occupational Opportunities and Training Needs for Agricultural Employment in Selected Areas of Arizona - Western Salt River Valley, Research Report 265, Agricultural Experiment Station, University of Arizona, Tucson, 1971

Loewen, Curtis Eugene. "A Curricular Model in Ornamental Horticulture for Vocational Agriculture in Oregon." Unpublished Ph. D. Dissertation Oregon State University.

McCormick, Floyd G. Specialized Curriculum in Horticulture for Arizona, Service Bulletin Number Fourteen, Department of Agricultural Education, University of Arizona, Tucson, 1972

Zurbrick, Phillip R. Occupational Opportunities and Training Needs for Agricultural Employment in Selected Areas of Arizona, Research Series Number Three, Department of Agricultural Education, University of Arizona, Tucson, Arizona 1973

Zurbrick, Phillip R. Occupational Opportunities and Training Needs for Agricultural Employment in Selected Areas of Arizona - Pima County, Research Report 268, Agricultural Experiment Station, University of Arizona, Tucson, 1972

APPENDIX A

List of Ornamental Horticulture Competencies Included in the Study

ORNAMENTAL HORTICULTURE COMPETENCIES

ABILITY TO:

1. Determine soil texture
2. Select and prepare propagation media
3. Prepare a soil nutrient solution with pre-mixed chemicals
4. Prepare a soil nutrient solution with self-mixed chemicals
5. Prepare a mulch
6. Select appropriate soil conditioners
7. Prepare topsoil for seeding
8. Take a soil sample for analysis
9. Identify plant and soil problems
10. Correct plant and soil problems

Propagate plants asexually using the following methods:

11. T-bud
12. Meristem culture
13. Patch-bud
14. Layering
15. Cleft graft
16. Whip and tongue graft
17. Identify annual plants
18. Identify bi-annual plants
19. Identify perennial plants
20. Identify grass species grown in Arizona by vegetative means
21. Culture bedding plants
22. Care for and water plants
23. Stake and tie plants
24. Pot plants
25. Prune nursery stock
26. Trim hedges
27. Mow and edge lawns
28. Plant and transplant
29. Select and identify root stock
30. Fertilize nursery stock
31. Retard and force plant growth
32. Select and use plant growth substances
33. Plant a lawn (seeding, plugging, sprigging)
34. Treat plant wounds and cuts
35. Store and handle seeds, bulbs and corms
36. Develop an espalier
37. Identify the proper exposure for best plant growth for common landscape plants
38. Store live plant materials

Identify plant diseases:

39. of trees
40. of nursery stock
41. of shrubs and bushes
42. of flowers

43. Control plant diseases
44. Test for virus free stock
45. Grow virus free stock
46. Kill virus in infected stock

Identify insect injury:

47. in trees
48. in nursery stock
49. in ornamentals

50. Identify weeds
51. Select chemicals for disease, insect and rodent control
52. Mix and handle chemicals
53. Apply systemic chemicals (fungicide, fertilizers, insecticides)
54. Select and apply appropriate fertilizer for lawns and landscape plantings
55. Do selective trimming and shaping trees
56. Trim parasite growth from trees
57. Prune branches to laterals making proper cuts
58. Remove heavy limbs using ropes for lowering
59. Work from a rope and saddle in trees
60. Use the basic rope knots for climbing and tree removals
61. Estimate the weight of limbs and the balance of trees
62. Identify utility lines (voltage amount)
63. Climb trees with the aid of spurs
64. Install cables and tree rod supports
65. Repair storm damage and uprooted trees
66. Do bark tracing and cavity treatment of diseased areas.
67. Install lightening rods in trees
68. Install "dead man" supports for trees
69. Identify root damage to trees (root bores, girdling roots)
70. Control root growth (chemically and mechanically)
71. Construct floral arrangements
72. Design floral pieces
73. Rake and properly care for sand traps
74. Reseed a turf area
75. Aerify greens, tees, fairways and roughs
76. Verti-cut greens
77. Change cups on golf green
78. Rebuild greens

79. Lay sod
80. Renovate old lawns
81. Measure and survey land
82. Irrigate turf
83. Operate a hydraulic deep-root feeding unit
84. Operate and maintain brush chippers
85. Operate and maintain an aerial tree trimming bucket unit
86. Operate and maintain a stump remover
87. Operate and maintain pumps
88. Operate and service automatic systems (water, heating, lighting and ventilation) on greenhouse, etc.
89. Operate and service small electric tools
90. Operate a sod cutter
91. Operate a chain saw
92. Operate crawler tractors
93. Operate a truck
94. Operate tillage equipment
95. Operate sprayers and dusters
96. Operate seeders and fertilizer applicators
97. Operate a rotary tiller
98. Operate tractors
99. Operate small gas engines
100. Operate reel, rotary and sickle bar mowers
101. Operate a cultivator
102. Maintain small gas engines
103. Maintain electric motors
104. Perform preventive maintenance on lawn and garden machinery
105. Perform daily care and maintenance on tractors
106. Make minor repair on small gas engines
107. Adjust and service belts and pulleys
108. Install and maintain sprinkler irrigation system
109. Condition garden tools (sharpen and/or repair)
110. Cut and replace glass
111. Perform simple welding repairs
112. Wire electrical outlets and devices
113. Paint wood and other surfaces
114. Construct wood projects
115. Repair and adjust tractors
116. Adjust carburetors
117. Lubricate moving parts on machinery
118. Adjust valves and set ignition timing on internal combustion engines
119. Layout and construct flower beds
120. Construct and use cold frames
121. Construct and use hot beds
122. Grade a site
123. Interpret a landscape plan

124. Figure cost in developing a site
125. Sketch and layout a landscape design
126. Lay masonary units
127. Mix, pour and finish concrete
128. Cut, thread and fit pipe
129. Install plastic pipe
130. Mark and tag products for sale
131. Maintain good relations with customers and fellow workers
132. Listen and observe
133. Keep employee time records
134. Operate a cash register
135. Make out monthly statements
136. Arrange stock and make displays
137. Order stock
138. Read scales
139. Help customer select what they need
140. Read sales tax table
141. Look neat and well groomed
142. Stay cheerful and helpful
143. Sell products and services
144. Keep records of expenses and receipts
145. Keep inventory and stock records
146. Explain or relay product knowledge
147. Transport, store and ship horticultural products

Understanding of:

148. Soil texture and structure
149. The effects of soil moisture on plants
150. The effect of water on soil temperature
151. The absorption rates of different soil types
152. The function of living organisms in the soil
153. Conditions for growth and development of plants
154. The types and uses of soil conditioners and mulches
155. The principles of sterilization (soil, buildings, and plants)
156. The effects on plant growth of temperature, humidity and light
157. Organic matter and its components
158. Cell and tissue structures of plants
159. Scientific names of plants
160. Floral crop production
161. Floral design
162. The life cycle of plants
163. The disease cycle of pathogenic organisms
164. Plant parts and their functions
165. Plant processes
166. Profit maximizing principles (economic principles)
167. Issuing credit
168. Insurance needs and coverages

169. Horticultural products and their uses
170. Marketing principles (price determination)
171. Market outlets and trends
172. The principles of landscape design
173. Chemical safety
174. Personal safety and first aid
175. Ball field and park maintenance
176. Low maintenance upkeep of recreational facilities
177. Local climatic area for plant growth
178. Management in a retail store
179. Marketing problems and practices
180. Budgets and analysis procedures
181. Efficient water use

APPENDIX B

Randomly Sampled Businesses Who Participated In Study

Businesses who participated in the study along with the job title for which they provided an appraisal.

BUSINESS	JOB TITLE
A. P. Nursery - Mesa	Nursery Salesman
Arizona Zoological Society - Phoenix	Groundskeeper
Arroyo Dunes Golf Course - Yuma	Greenskeeper
Baker Nursery - Phoenix	Landscape Gardener
Cliff Valley Golf Course - Tucson	Greenskeeper
Del Camino Nursery - Tempe	Nursery Worker
Desert Lawn Memorial Park - Yuma	Landscape Gardener
Harlow Nursery - Tucson	Nursery Salesman
Haws & Sons Nursery - Mesa	Nurseryman
Hidden Valley Golf Course - Tucson	Groundskeeper
Hillander C. Groves - Yuma	Nursery Worker
Jim Wheat Landscape Center - Tempe	Nursery Salesman
Marsitto Nursery - Mesa	Nurseryman
Mission Gardens Nursery - Mesa	Nurseryman
Plant World - Mesa	Nursery Salesman
Phoenix, Parks Department - Phoenix	Landscape Gardener
Sun City Country Club - Sun City	Laborer, Golf Course
Sun City Nursery - Sun City	Nursery Salesman
Walter's Garden Center - Prescott	Nurseryman
Willinger's Turf - Phoenix	Greenskeeper
Woody's Landscape and Tree Service-Mesa	Landscape Gardener
Your Florist - Yuma	Nurseryman
Yucca Granite and Landscaping - Mesa	Landscape Gardener